Space Weather Technical Forecast

Issued on Wednesday 29 January 2025 at 13:15 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares. G1 minor geomagnetic storms likely 31 Jan with HSS connection.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Moderate, with two M-class flare in the last 24 hours, peaking at a M1.7 recorded at 28/1945 UTC, and originating from AR3977.

There are currently five sunspot regions visible on the Earth-facing side of the Sun, with AR3967 and AR3975 fading from view. Many of these are located near the limbs, making detailed analysis challenging. AR3976, AR3977 and AR3978 are emerging from the north-eastern limb and represent the bulk of current activity and magnetic complexity, warranting further analysis as they move onto the solar disc. The remaining sunspots are small and magnetically simple.

No Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE/DSCOVR at L1, was at generally background levels, ranging from 300-360km/s with some weak CME influence likely. Density was average or just below. The Interplanetary Magnetic Field, Bt, was mostly weak, but peaked at near 10nT. The north-south component, Bz, mostly varied weakly between +/-7nT. The phi angle fluctuated but was mostly positive (Away from the Sun). Geomagnetic activity was Quiet to briefly Active (Kp1-4).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at background to moderate levels. The associated 24-hour fluence persisted below the Active threshold, recording 3.21e6 integrated pfu at 29/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected with a chance of isolated M-class flares, and a very slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast, with the outlook dominated by the large recurrent coronal hole, CH11/+, near centre disk. This

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feature is expected to bring an increases of solar winds from current background levels towards elevated or strong levels, 550-650km/s, from later Day 2 (30 Jan) or more likely through Day 3 (31 Jan).

Generally Quiet activity (Kp1-2) expected initially. Activity expected to increase to become generally Unsettled to Active (Kp3-4) from late Day 2 (30 Jan) onwards, with the chance of G1 minor storm intervals increasing to a likelihood on Day 3 (31 Jan) with the expected connection to CH11/+.

Energetic Particles / Solar Radiation: There is a slight chance of enhancements exceeding the S1/Minor Radiation Storm threshold at first, should any larger flares occur from over the western limb.

GOES16 high energy electron flux is expected to remain at background to moderate levels. The corresponding 24-hour fluence is expected to remain below the Active threshold on a declining trend.

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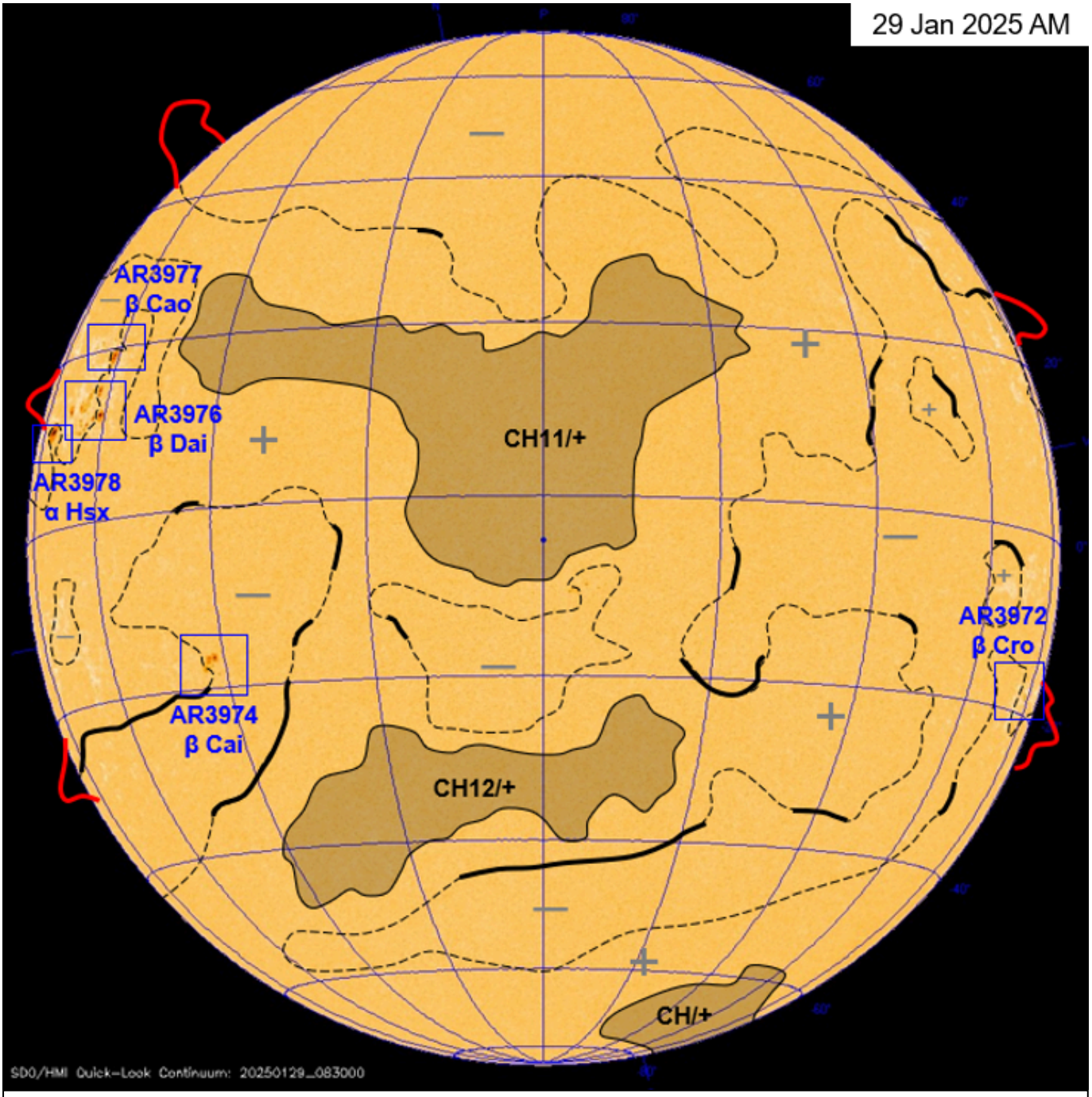
Figure 1: Solar Synoptic Map valid 29/0830UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth-directed CMEs currently feature in the forecast, with the outlook dominated by the large recurrent coronal hole, CH11/+, near centre disk. This feature is expected to bring an increases of solar winds from current background levels towards elevated or strong levels, 550-650km/s, from later Day 2 (30 Jan) or more likely through Day 3 (31 Jan), with good support from both recurrence and MOSWOC ENLIL output. Solar wind speeds are then expected to remain at elevated or strong levels throughout the remainder of the forecast period.

Generally Quiet activity (Kp1-2) expected initially. Activity expected to increase to become generally Unsettled to Active (Kp3-4) from late Day 2 (30 Jan) onwards, with the chance of G1 minor storm intervals increasing to a likelihood on Day 3 (31 Jan) with the expected connection to CH11/+.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	1	20	60	40
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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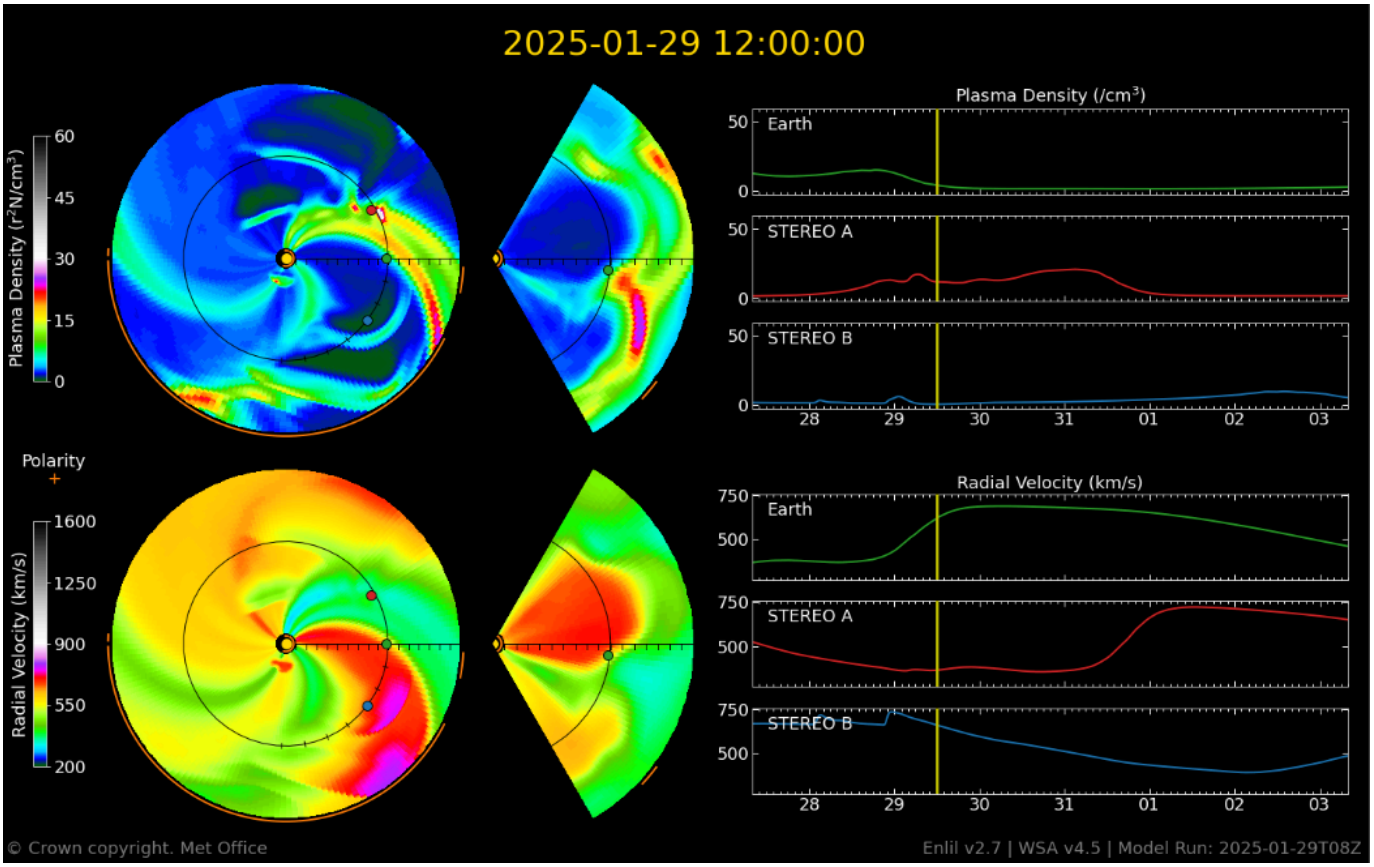
Figure 2: Latest MOSWOC ENLIL output, HSS clearly visible in output, but viewed as likely somewhat too early to increase solar winds.



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Radio Blackouts - X-Ray Flares

Trends in the coming four-day forecast period will rely on the character of new regions emerging over the eastern and particularly north-eastern limb. Regions AR3976, AR3977 and AR3978 continue to emerge around the north-eastern limb, providing the bulk of current flare risk and activity. These regions may correspond to previously active regions Ex-AR3947 and Ex-AR3953 from the last solar rotation, and isolated moderate activity has already been observed. It remains to be seen if the recently numbered AR3978 will show more complexity in the coming hours as suggested by SDO imagery, with both recurrence and far-side helioseimic data suggesting the potential for further regions to rotate on during the first half of the period. The remaining sunspots are small and magnetically simple with recent larger western hemisphere regions representing a quickly declining risk as they continue to rotate away.

Overall, the daily flare risk is kept steady over the coming days pending further developments, somewhat below the average level. Generally Low to Moderate solar activity is expected with a chance of isolated M-class flares and a slight chance of isolated X-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	40	40	40	40
Very Active	R3-R5 (X Class)	No	5	5	5	5

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Solar Radiation Storms (High Energy Protons)

Proton flux is currently at background levels, and expected to remain so in the absence of significant solar flaring. There remains a slight chance of flux rising above the S1/Minor Radiation Storm threshold however, particularly to start due to the lingering threat from AR3961 which is now well over the western limb, this risk then declines.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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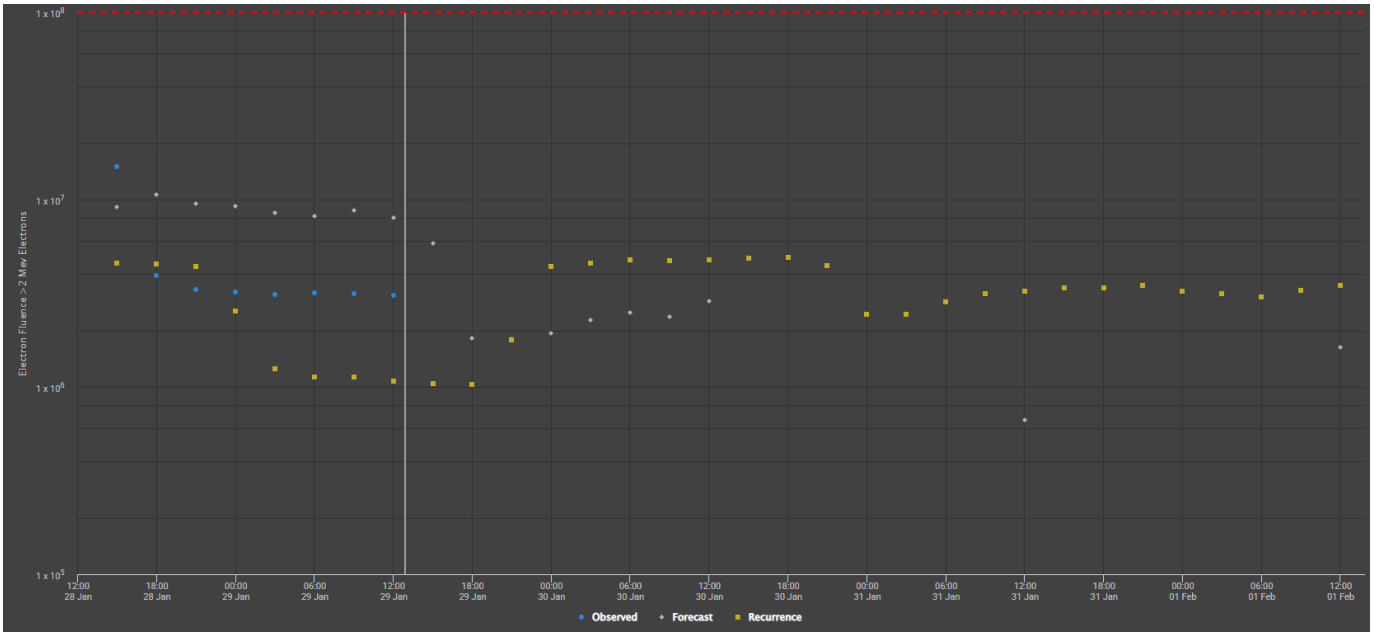
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been at background to moderate levels over the past 24 hours. Flux levels are expected to remain at similar levels through the forecast period.

The corresponding 24-hour fluence is expected to remain below the Active threshold, with a gradual downward trend. MOSWOC REFM is felt to be giving reasonable guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 3: Latest MOSWOC REFM output.



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